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Effects of input uncertainty and variability on the modelled environmental fate of organic pollutants under global climate change scenarios

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Abstract:

Global climate change (GCC) is expected to influence the fate, exposure and risks of organic pollutants to wildlife and humans. Multimedia chemical fate models have been previously applied to estimate how GCC affects pollutant concentrations in the environment and biota, but previous studies have not addressed how uncertainty and variability of model inputs affect model predictions. Here, we assess the influence of climate variability and chemical property uncertainty on future projections of environmental fate of six polychlorinated biphenyl congeners under different GCC scenarios using a spreadsheet version of the ChemCAN model and the Crystal Ball (R) software. Regardless of emission mode, results demonstrate: (i) uncertainty in degradation half-lives dominates the variance of modelled absolute levels of PCB congeners under GCC scenarios; (ii) when the ratios of predictions under GCC to predictions under present day climate are modelled, climate variability dominates the variance of modelled ratios; and (iii) the ratios also indicate a maximum of about a factor of 2 change in the long-term average environmental concentrations due to GCC that is forecasted between present conditions and the period between 2080 and 2099. We conclude that chemical property uncertainty does not preclude assessing relative changes in a GCC scenario compared to a present-day scenario if variance in model outputs due to chemical properties and degradation half-lives can be assumed to cancel out in the two scenarios.

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Resource Description

Climate Scenario : ⊠

specification of climate scenario (set of assumptions about future states related to climate)

 Other Climate Scenario

Other Climate Scenario: author defined scenarios

Exposure : ⊠

weather or climate related pathway by which climate change affects health

 Air Pollution, Temperature

Air Pollution: Other Air Pollution

Air Pollution (other): PCB

Temperature: Fluctuations

Geographic Feature: ☒

resource focuses on specific type of geography

None or Unspecified

Geographic Location: ☒

resource focuses on specific location

Global or Unspecified

Health Impact: ☒

specification of health effect or disease related to climate change exposure

Health Outcome Unspecified

Mitigation/Adaptation: ☒

mitigation or adaptation strategy is a focus of resource

Mitigation

Model/Methodology: ☒

type of model used or methodology development is a focus of resource

Exposure Change Prediction

Resource Type: ☒

format or standard characteristic of resource

Research Article

Timescale: ☒

time period studied

Long-Term (>50 years)